Linking changes in flow to changes in macroinvertebrate communities

Understanding the effects of flow access rules on the ecosystems of unregulated rivers

Project description

In New South Wales (NSW), low-flow access rules under water sharing plans and water resource plans are the primary tool for managing extraction from unregulated rivers. Unregulated rivers are those that are unmodified, without dams or weirs.

Macroinvertebrates are small animals that have no backbone and spend at least some of their lifecycle in the water. This includes flies and other insects, worms, snails, mussels and yabbies. These are an important part of the food web but have short life cycles, so they can be easily sampled without negatively affecting the ecology.

Low-flow access rules are critical for preventing unnatural reduced flow and drying of the riffle (rocky or shallow) habitat. These rules can help to achieve the ecological objectives of plans and the Basin-wide Environmental Watering Strategy, including the protection of macroinvertebrates.

This project aims to develop a model that can predict changes to macroinvertebrate communities in response to flow regimes at a given location, modelled with and without low-flow access rules. This will enable us to assess how effective the current rules are at achieving ecological objectives around protecting in-stream macroinvertebrates.

Water sharing plan

This study relates to the NSW *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012.*

Study design

Every 12 weeks, macroinvertebrates are collected from riffle habitats at seven sites in tributaries of the Tumut and Murrumbidgee Rivers (Figure 1). The sites are next to flow gauges, allowing us to directly link flow conditions between sampling times to changes in macroinvertebrate communities. The sites represent a range of hydrological conditions—some sites are perennial and have high baseflows, while others regularly experience zero-flow periods. We first collected samples in February 2019 and will continue to for two years. On each sampling trip, and at each location, water quality is also measured.

After sampling is complete, we will determine changes in macroinvertebrate community composition. We will also investigate changes in total biomass and nutritional composition of macroinvertebrate communities. This will allow us to examine:

- changes to the composition of macroinvertebrate communities in response to low flows
- how these changes may affect stream food webs.

We will compare and relate changes in communities to the preceding flow patterns. This will be used to develop a model that can predict how macroinvertebrates respond to changes in flow regimes, particularly to low flows.

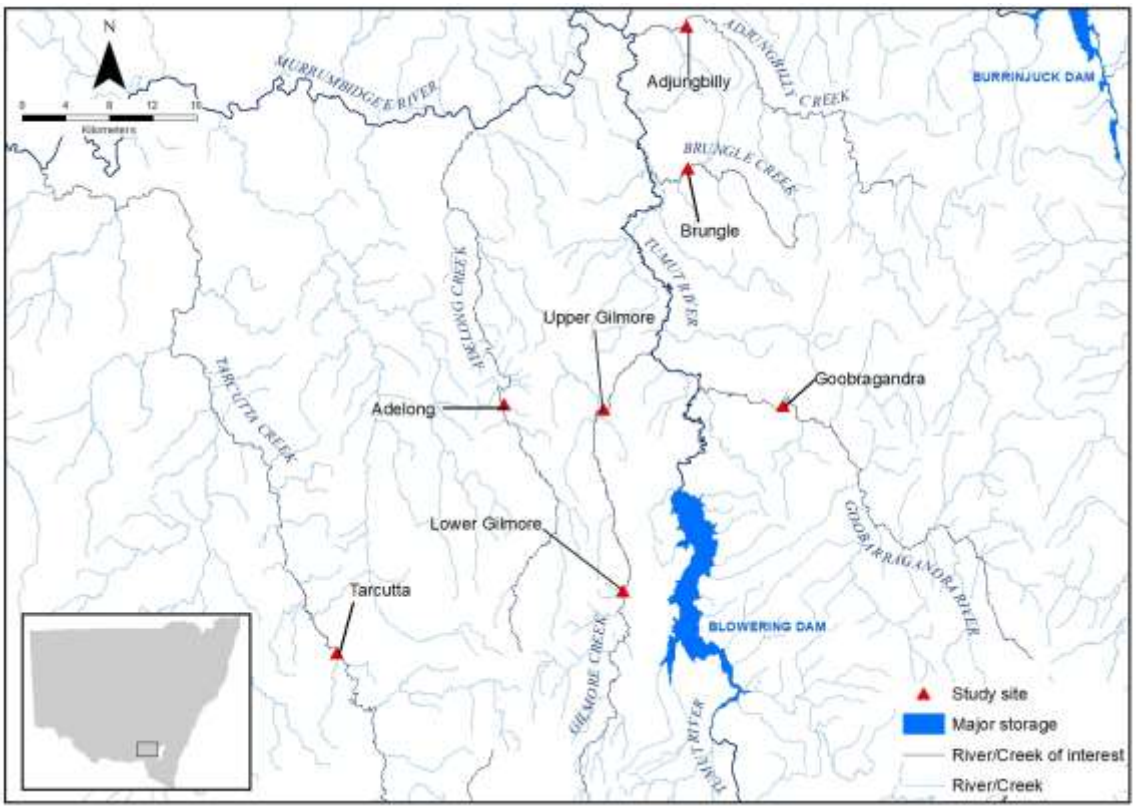

Figure 1. Seven study sites were selected in tributaries of the Murrumbidgee and Tumut Rivers.

Outcomes

We have sampled five water-quality features—electrical conductivity (a measure of salinity), temperature, turbidity, dissolved oxygen and pH—four times between February 2019 and November 2019 (Figure 2). Water quality varies between the sites as well as over time. This data is collected, as it may explain changes in macroinvertebrate communities that cannot be attributed to hydrology.

The seven study sites represent a range of flow regimes (Figure 3a). Goobragandra had higher base flows than the other sites and is unlikely to experience zero-flow periods. In comparison, flow at Brungle was regularly below 1 ML per day between November 2018 (three months prior to the first sampling trip) and November 2019 (the most recent sampling trip).

Flow volumes also vary over time. Between November 2018 and November 2019, daily flow at each of the seven sites fell below cease-to-pump (CtP) levels identified in the NSW *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012* (Figure 3b-h, Table 1). Cease-to-pump rules are designed to protect water sources during times of natural low flow by restricting water extraction once the flow falls below the cease to pump.

Some water sharing plan areas do not have cease-to-pump rules. Instead, they refer to ‘no visible flows’ as the rule that restricts water extraction. This is the case in many water sources, including Brungle Creek, and it effectively allows the river to dry out before water access is restricted.

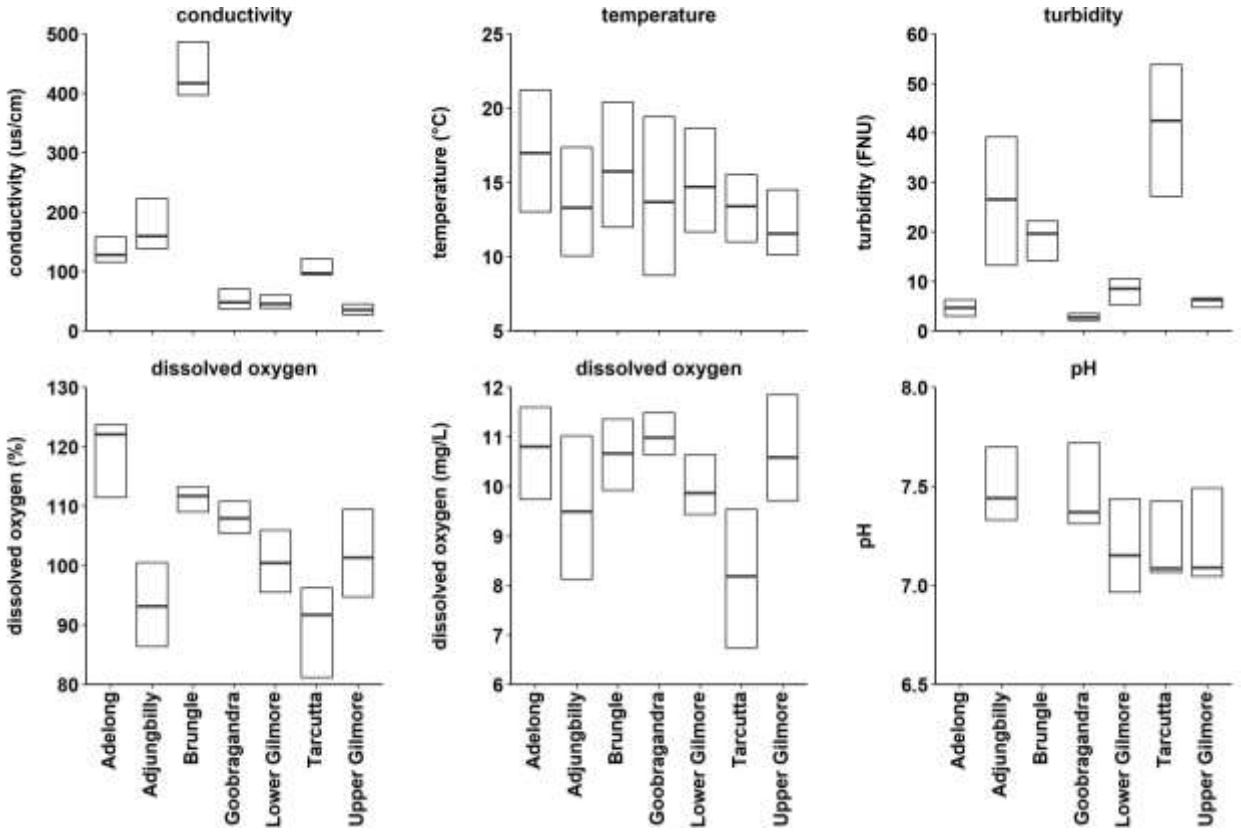

Figure 2. Box plots of water quality metrics, as measured on four sampling trips between February 2019 and November 2019 at seven study sites. Horizontal bars indicate median values and the box represents the 25th and 75th percentiles.

Table 1. Cease-to-pump trigger levels for the seven sites and the number of days between November 2018 and November 2019 where flow was less than or equal to the cease-to-pump level at that site.

Site	CtP trigger level (ML/day)	Days below or equal to CtP
Adelong	12	153
Adjungbilly	14.3	97
Brungle	No visible flow	N/A
Goobragandra	63	35
Lower Gilmore	10	39
Tarcutta	18	71
Upper Gilmore	10	59

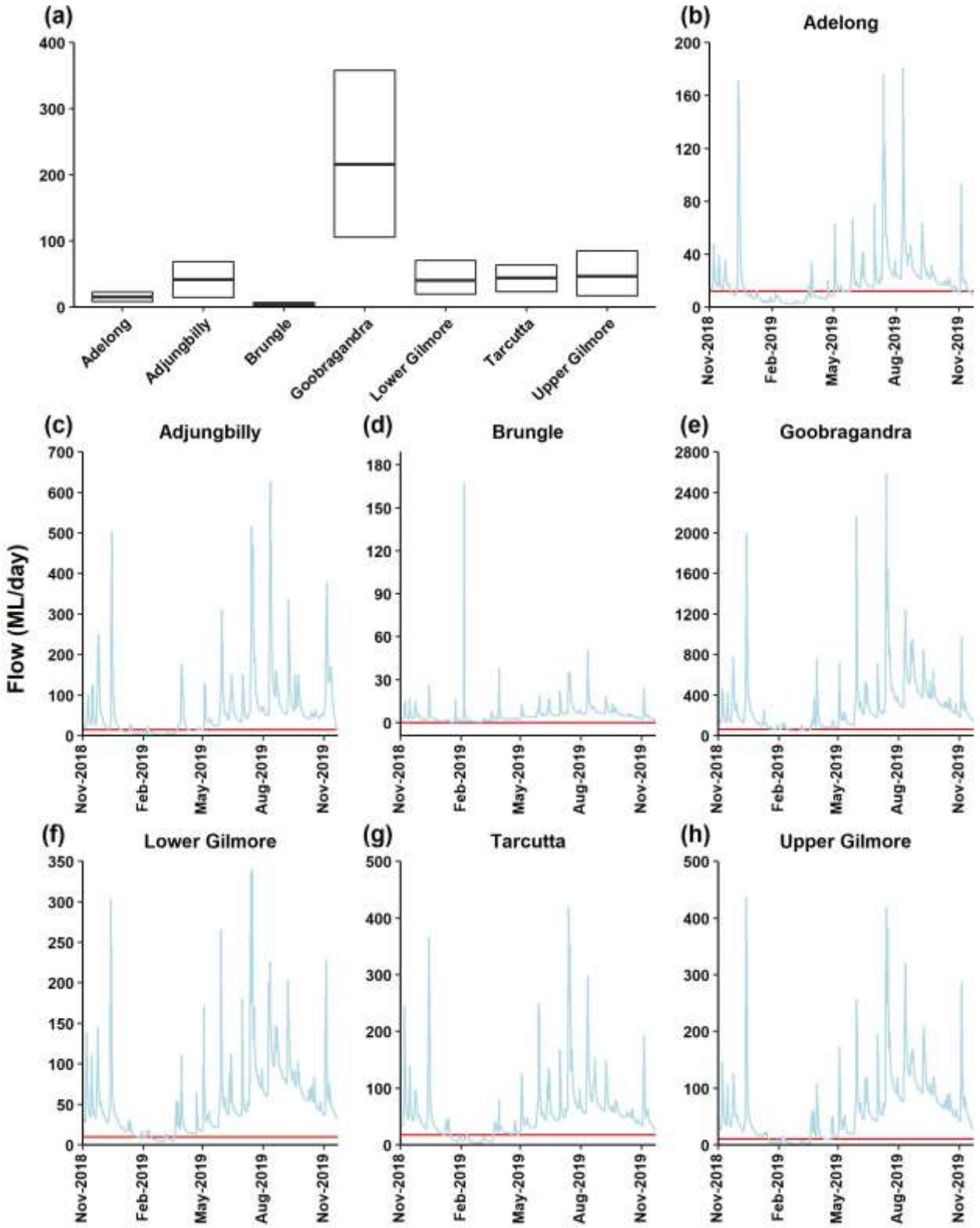

Figure 3. (a) Box plot summarising daily flow (ML) recorded at gauges adjacent to seven sampling sites between November 2018 and November 2019. Horizontal bars indicate median values for the period and the box indicates the 25th and 75th percentiles. (b-h) Daily flow at each site. The cease to pump triggers for each water course are depicted in red. At Brungle, the cease-to-pump level of 'no visible flow' has been interpreted as 0 ML/day.

The analyses of water quality and hydrology are a preliminary assessment of the data. These analyses will be expanded upon as more data is collected. Macroinvertebrate sampling and water quality measurement will continue until the end of 2020. At that time, all samples will be analysed in terms of the taxonomy, total biomass and nutritional composition.

Any changes in macroinvertebrate communities between sampling events can then be compared against changes in hydrology. This information will be used to develop a flow-ecology model which can predict macroinvertebrate responses to different flow regimes. This predictive model will allow us to evaluate water management strategies, including low-flow access rules and cease-to-pumps. It will also assess the effectiveness of such strategies for meeting the Basin-wide Environmental Watering Strategy and water sharing plan and water resource plan objectives, which aim to protect important river-flow-dependent ecosystems, such as macroinvertebrate communities.

More information

For more information about this project, contact water.science@dpie.nsw.gov.au